Arterial Spin Labeling (ASL)

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What is ASL?

• Arterial spin labeling uses arterial blood water as an endogenous contrast agent
• Blood is “tagged,” or magnetically inverted, which changes its magnetic properties and its effect on MR signal
• Advantages: non-invasive, fast, better spatial specificity than BOLD
• Also, can quantify CBF (cerebral blood flow)
Principles of ASL

1. Tag inflowing arterial blood by magnetic inversion
2. Acquire the tag image

3. Repeat experiment without tag
4. Acquire the control image

5. Subtract: Control image - Tag Image

The difference in magnetization between control and tag conditions is proportional to regional cerebral blood flow.

http://www.umich.edu/~fmri/asl.html
BOLD vs. ASL

- Brain tissue = diamagnetic = inert
- Oxy blood = diamagnetic = inert
- Deoxy blood = paramagnetic = decrease

- BOLD signal produced by rinsing (displacement) of deoxy blood by oxy blood
- In ASL, create paramagnetic tracer that suppresses MR signal wherever arterial blood is delivered
# BOLD vs. ASL

<table>
<thead>
<tr>
<th></th>
<th>BOLD</th>
<th>ASL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contrast:</strong></td>
<td>T2</td>
<td>T1 (Star)</td>
</tr>
<tr>
<td><strong>Spatial:</strong></td>
<td>Veinules</td>
<td>Arterioles/Capillaries</td>
</tr>
<tr>
<td><strong>Sample Rate (TR):</strong></td>
<td>High</td>
<td>Low (Star)</td>
</tr>
<tr>
<td><strong>Intersubject Var:</strong></td>
<td>Whole-Brain (Star)</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Coverage:</strong></td>
<td>Susceptibility; motion</td>
<td>Part or Most</td>
</tr>
<tr>
<td><strong>Artifacts:</strong></td>
<td>0.5-5% (Star)</td>
<td>Vascular Artifact</td>
</tr>
<tr>
<td><strong>% Signal Change:</strong></td>
<td>Task Design</td>
<td>&lt;1%</td>
</tr>
<tr>
<td><strong>Ideal for:</strong></td>
<td></td>
<td>Physiological States</td>
</tr>
</tbody>
</table>

Excerpt from [http://bitc.bme.emory.edu/BOLD_ASL.html](http://bitc.bme.emory.edu/BOLD_ASL.html)